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Electrogalvanized Hot Rolled and Cold Reduced Carbon Steel Sheets and Strips — Specification

ICS 77.140.50

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Wrought Steel Products Sectional Committee, MTD 04

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Electrogalvanizing is a process in which a layer of zinc is bonded to steel in order to protect it against corrosion. The process involves electroplating, running a current of electricity through a saline/zinc solution with a zinc anode and steel conductor. One of the major benefits of electrogalvanizing process is that lower and / or differential coating thicknesses can be achieved by it which is not usually possible by traditional hot dip galvanizing process.

Electrogalvanized steel products are now being used increasingly in various application. As the process of electrogalvanizing is totally different from hot dip galvanizing process, the committee decided to formulate a new standard on the subject. Assistance has been derived from ISO 5002 : 2013 'Hot-rolled and cold-reduced electrolytic zinc-coated carbon steel sheet of commercial and drawing qualities' during the formulation of this standard.

The composition of the Committee and the Panel responsible for the formulation of this standard is given at Annex A.

For the purpose of whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ELECTROGALVANIZED HOT ROLLED AND COLD REDUCED CARBON STEEL SHEETS AND STRIPS — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements of hot rolled and cold reduced carbon steel sheets and strips coated with zinc by electrolytic process.

1.2 The product can be coated on one or both the surfaces and with equal or differential coating masses on the two surfaces.

2 REFERENCES

The following standards contain provisions which through in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
513 (Part 1) : 2016	Cold reduced carbon steel sheet and strip : Part 1 Cold forming and drawing purpose (*sixth revision*)
513 (Part 2) : 2016	Cold reduced carbon steel sheet and strip : Part 2 High tensile and multi-phase steel (*sixth revision*)
1079 : 2017	Hot rolled carbon steel sheet and strip (*seventh revision*)
1608 (Part 1) : 2018/ ISO 6892-1 : 2016	Metallic materials — Tensile testing : Part 1 Method of test at room temperature (*fourth revision*)
1956 (Part 4) : 2013	Glossary of terms relating to iron and steel : Part 4 Flat products (*second revision*)
3531 : 1997	Glossary of terms relating to corrosion of metals (*second revision*)
3554 : 2017	Glossary of terms relating to electroplating (*first revision*)
5986 : 2017	Hot rolled steel sheet and strip for forming and flanging purposes (*fourth revision*)
6745 : 1972	Methods for determination of mass of zinc coating on zinc coated iron and steel articles
8910 : 2010 / ISO 404 : 1992	General technical delivery requirements for steel and steel products (*first revision*)
12860 : 1989	Metallic coating thickness by X-Ray fluorescence technique method — Determination
13229 : 1991	Zinc for galvanizing

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 1956 (Part 4), IS 3531, IS 3554 and the following definitions shall apply.

3.1 Thickness of Sheet — Nominal thickness of hot rolled or cold reduced carbon steel sheet and strip without any coating on it. This is also termed as BMT (base metal thickness). This is the thickness that should be used while ordering the coated steel. In case of coated steel, it is measured after removing the coating.

3.2 Coating Mass — The amount of coating expressed in grams per unit surface area of sheet (g/m^2).

3.3 Product — Electrogalvanized hot rolled and cold reduced carbon steel sheet and strip.

4 DESIGNATIONS

4.1 Coating Class

Expressed as EG “XXX”, where ‘XXX’ is the coating mass in g/m^2.

4.2 Base Metal Grade

It is the grade of the steel mentioned in the respective base metal specifications.

4.3 Designation of electrogalvanized hot rolled and cold reduced carbon steel sheet and strip

The designation is the combination of base metal grade and the coating class separated by ‘hyphen’.

Example — Electrogalvanized cold reduced carbon steel sheet having base metal of carbon steel grade ISC410LA coated with coating class of EG070, the designation of that electrogalvanized cold reduced carbon steel sheet will be: ISC410LA-EG070.

5 SUPPLY OF MATERIAL

The general requirements relating to supply of electrogalvanized hot rolled and cold reduced carbon steel sheet and strip shall conform to IS 8910.

6 MANUFACTURE

6.1 The base metal of electrogalvanized hot rolled carbon steel sheet and strip shall be manufactured as per IS 1079 or IS 5986.

6.2 The base metal of electrogalvanized cold reduced carbon steel sheet and strip shall be manufactured as per IS 513 (Part 1) or IS 513 (Part 2).

6.3 The zinc used for galvanizing shall conform to any of the grades specified in IS 13229.

7 CHEMICAL COMPOSITION

7.1 The chemical composition of base metal of electrogalvanized hot rolled carbon steel sheet and strip shall be as per the requirements given for the respective grades mentioned in IS 1079 or IS 5986. The chemical composition of base metal of electrogalvanized cold reduced carbon steel sheet and strip shall be as per the requirements given for the respective grades mentioned in IS 513 (Part 1) or IS 513 (Part 2).

7.2 Testing Frequency

One sample per heat of the base metal to be tested after stripping the coating from it.

8 TENSILE TEST

8.1 Test Piece

The tensile test piece shall be cut parallel or perpendicular to the direction of rolling.

8.2 Testing Frequency

Sample shall be collected and tested for each mother coil and the part thereof.

8.3 Testing

8.3.1 When tested as per IS 1608 (Part 1), the mechanical properties, that is, yield strength, tensile strength and % elongation of the electrogalvanized hot rolled and cold reduced carbon steel sheet and strip shall meet the requirements specified for the corresponding grade of base metal mentioned in IS 1079 or IS 5986 or IS 513 (Part 1) or IS 513 (Part 2).

8.3.2 Testing shall be done on dumb-bell shaped tensile test samples. Width of the dumbbell to be 12.5 mm for 50 mm gauge length and 20 mm for 80 mm gauge length samples. Testing shall be carried out at the ambient temperature.

9 COATING

9.1 Coating mass

The amount of coating mass expressed in grams per surface of the product shall conform to the requirements specified in the Table 1.

Table 1 Coating Class and Coating Mass

(*Clause* 9.1)

Sl.No. (1)	Coating Class (2)	Coating Mass per Surface g/m² *Min* (3)	Coating Mass per Surface g/m² *Max* (4)
i)	EG000	0	0
ii)	EG005	5	20
iii)	EG010	10	30
iv)	EG015	15	35
v)	EG020	20	40
vi)	EG030	30	50
vii)	EG040	40	70
viii)	EG050	50	80
ix)	EG060	60	90
x)	EG070	70	100
xi)	EG080	80	110
xii)	EG090	90	130
xiii)	EG100	100	140

NOTES

1 Coating classes other than and within the range specified above shall be as per the mutual agreement between the customer and the supplier.

2 Differential coating — A coating which has a substantially different coating mass on each side of the steel sheet or strip. This shall be as per agreement between the purchaser and the supplier.

3 Equally coated material should be designated as EG010, for example. Differentially coated material should be designated as EG050/010, for example. Single-surface-coated material should be designated as EG020/000, for example.

9.1.1 Coating Mass Test

9.1.1.1 The coating mass of the product is to be tested by taking a sample piece from each coil approximately 300 mm in length from each coil, and cutting three test specimens, one from the mid-width position and one from each side, not closer than 25 mm to the side edge. The minimum area of the three specimens shall be 1 200 mm^2.

9.1.1.2 The coating mass shall be the minimum coating mass found on any one of the three specimens taken in accordance with **9.1.1.1**.

9.1.1.3 The coating mass shall be determined by X-ray fluorescence method (*see* IS 12860) or by weight loss (Gravimetric) method (*see* IS 6745). In case of differential coating, the coating mass of the product is to be tested by X-ray fluorescence method only.

9.1.1.4 When the purchaser wishes to relate the thickness of coating to the mass of coating then the coating thickness can be found from the coating weight (mass) by using the following relationships:

a) 1.00 g/m^2 coating mass = 0.140 micrometer coating thickness; and

b) 1.00 micrometer coating thickness = 7.14 g/m^2 coating mass.

9.2 Coating Adherence

9.2.1 The product shall be capable of being bent in any direction, in accordance with the mandrel diameter requirements given in Table 2.

Table 2 Coating Bend Test Requirements for Electrogalvanized Hot rolled and Cold Reduced Steel Sheet and Strip

(*Clause* 9.2.1)

Sl No	Material	180° Bend Mandrel Diameter	
		e < 3	e ≥ 3
(1)	(2)	(3)	(4)
i)	Electrogalvanized Hot rolled carbon steel sheet and strip	0	1.0 a
ii)	Electrogalvanized Cold reduced carbon steel sheet and strip	0	0

NOTES

1 *e* is the thickness of the sheet in millimetres.

2 *a* is the thickness of bend test piece.

9.2.2 *Coating Adhesion Test*

One test specimen per coil is to be tested from any part of the sample. Minimum test specimen width shall be 50 mm. Both surfaces of the test specimen shall be capable of being bent 180° around a mandrel with diameter specified in Table 2 without flaking of coating or loss of coating during bend test. Failure of coating within 5 mm of the edge of the test specimen shall be disregarded. Electrogalvanized coatings are usually tightly adherent, even when used for difficult forming operations. However, powdering is possible if the material is severely formed or coined during forming.

10 DIMENSIONS, SHAPE AND TOLERANCES

10.1 Coil Internal Diameter

10.1.1 Unless otherwise agreed, internal diameter of coils shall be 508 mm (±10 mm).

10.2 Dimensions and Tolerances

10.2.1 The dimensions and tolerances of width, length and thickness of base metal of electrogalvanized hot rolled carbon steel sheet and strip shall be as per the requirements given in IS 1079 or IS 5986.

10.2.2 The dimensions and tolerances of width, length and thickness of base metal of electrogalvanized cold reduced carbon steel sheet and strip shall be as per the requirements given in IS 513 (Part 1) or IS 513 (Part 2).

11 RE-TESTING

11.1 When a part of the test results fails to comply with the requirement specified, a re-test (two more sets of test samples shall be taken for specific test requirements from the same lot) on the relevant items may be carried out to determine whether it is acceptable or not. If any of the re-test samples fail to meet the test requirements of this standard, the lot represented by the sample shall be deemed as not conforming to this standard.

12 STRAIN AGEING

12.1 Electrogalvanized carbon steel sheets and strips tends to strain age and this may lead to the following:

a) Surface marking from stretcher strains or fluting when the steel is formed, and;

b) Deterioration in ductility.

12.2 Strain ageing can be caused by either carbon or nitrogen atoms, which exist in a supersaturated solid solution and diffuse to dislocation sites with time and temperature. The addition of aluminium in sufficient quantities causes the removal of nitrogen from solid solution as particles of aluminium nitride. This practice tends to minimize room temperature ageing due to nitrogen and results in the general understanding that cold-rolled aluminium killed steel is free of ageing. However, carbon, which is usually not retained in solid solution with the slow cooling typical of batch annealing, can be retained in solid solution during the continuous annealing process. If the annealing process and steel chemistry are not properly controlled, material with carbon remaining in solid solution after continuous annealing may result and such material will strain age at room temperature and the problems noted above can occur. Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Stocking of such steels for extended periods of time should be avoided. For skin-passed sheet, effective roller leveling immediately prior to fabrication at the manufacturer's plant can achieve reasonable freedom from stretcher strain. Freedom from stretcher strain for a period of 6 months from the date of manufacture can be achieved by the supply of skin-passed non-ageing steel.

12.3 The details given above is for information and the manufacturer may adopt the same at his discretion.

13 SURFACE TREATMENT OF ELECTROGALVANIZED CARBON STEEL SHEETS

13.1 General

The surface treatment of electrogalvanized carbon steel sheets and strips is to be done, if requested by the purchaser, and as per the agreement between the purchaser and the supplier and as per mutually agreed procedure. The requirements for solutions used in surface treatments for paint preparation, surface passivation, or both should be agreed upon between the interested parties at the time of ordering, taking into consideration the user's paint schedule and paint systems. Typical surface treatment procedures that can be adopted are given below for information of purchaser and supplier.

13.2 Surface Preparation for Painting

Electrogalvanized steel sheet/strips may be processed chemically (such as phosphating or other suitable methods) at the site of manufacturer to prepare the sheet/strip for painting without further treatment, except normal cleaning, if required.

13.3 Passivation

A chemical treatment is normally applied to zinc coating to minimize the hazard of wet storage stain (white rust) during shipment and storage. The type of chemical treatment may be agreed upon between the manufacturer and the purchaser. However, the inhibiting characteristics of the treatment are limited and, if the material becomes wet during shipment or storage, the material should be used immediately or dried.

13.4 Oiling

The electrolytic zinc-coated steel sheet as produced may be oiled to minimize wet storage stain. When the zinc-coated sheet has received a passivation treatment, oiling will minimize further the hazard of wet storage stain. Removal of the oil may create difficulties (such as staining) if an unsuitable cleaning solution is used.

13.5 Painting

Electrogalvanized steel sheet is a suitable base for paint but the first treatments may be different from those used on mild steel. Pretreatment primers, chemical conversion coatings, and some paint specially formulated for direct application to zinc surfaces are all appropriate first treatments for electrogalvanized sheet.

14 PACKING

Electrogalvanized carbon steel sheets and strips should be suitably packed to avoid any transit/handling/storage damage and as per the agreement between the purchaser and the supplier.

15 MARKING

The following shall be legibly and indelibly marked on the top of each coil or package of sheets or shown on a tag attached to each coil or packet:

a) IS No. of this standard;
b) Manufacturer's name or trade-mark;
c) Material identification/coil number/packet number/batch number, etc;
d) Product dimensions;
e) Number of sheets or mass;
f) Designation of electrogalvanized hot rolled and cold reduced carbon steel sheet/strip; and,
g) Date of manufacture.

16 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Wrought Steel Products Sectional Committee, MTD 04

Organization	*Representative(s)*
In Personal Capacity (Kolkata)	Shri P. K. Sen
Tata Steel Ltd (Jamshedpur)	Shri Avtar Singh Saini Shri Sudipto Sarkar (*Alternate*)
Tata Blue scope steel ltd (Pune)	Shri Rajesh Maheshwari
All India induction furnance association (New Delhi)	Shri Prabhakar Mishra Shri Ashok Jain (*Alternate*)
Bharat Heavy Electrical ltd (Bhopal)	Shri S. K. Mahajan Shri Arun Khare (*Alternate*)
Central Boilers Board (New Delhi)	Shri T. S. G. Narayannen Shri S. K. Jain (*Alternate*)
DGS & D (New Delhi)	Shri A. K. Jain Shri A. K. M. Kashyap (*Alternate*)
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JSW steel Ltd. Raigad-402107 (Maharashtra)	Shri Subhasis Chakraborty Shri Atul Thorat (*Alternate*)
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Ministry of Defence (DGQA) (Ichapur, WB-743144)	Shri N. K. Murthy Shri D. C. Kar (*Alternate*)
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Ministry of Steel (Govt. of India) (New Delhi)	Shri Paramjeet Singh Shri S. K. Bhatnagar (*Alternate*)
Power Grid Corporation (Haryana)	Shri K. K. Tyagi Shri Deepak Kr Sahoo (*Alternate*)
Rashtriispat Nigam (Vishakapatnam)	Shri Raja Raman G. Shri Sanjay Roy (*Alternate*)
SAIL, Bhalai Steel Plant (Bhilai)	Shri Sandip Choudhur Shri K. L. Balasubramanjan (*Alternate*)
SAIL, Bokaro Steel Plant (Jharkhand-827011)	Smt Biswasi Sunita Minz Smt Roselin Dodrae (*Alternate*)
SAIL, Central Marketing Organisation (New Delhi)	Shri Amitava Kunda
SAIL, Research & Development center for Iron & Steel (Ranchi)	Dr Santosh Kumar Shri B. Sarkar (*Alternate*)
SAIL, Rourkela Steel Plant (Rourkela)	Shri A. Dasgupta Shri C. Samal (*Alternate*)

Organization	*Representative(s)*
Tata Motors Ltd (Pune)	Shri K. V. L. Narsimha Rao Shri U. B. Pathak (*Alternate*)
Society of Indian Automobile Manufacturers (SIAM) (New Delhi)	Shri Sushil Kumar Shri Kartikekarwal (*Alternate*)
The Tin Plate Company of India Ltd (Jameshedpur)	Shri S. J. Dev Shri Abesh Chatterjee(*Alternate*)
Jindal Steel & power ltd (JSPL)	Shri Moreshwar Borkar Shri Ashwani Kumar (*Alternate*)
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SAIL (Durgapur)	Shri Amarnath Banerjee
Essar Steel (Surat)	Shri Deepak Gupta Shri Bobby Pujara (*Alternate*)
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In individual capacity (New Delhi)	Shri A. C. R. Das
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Member Secretary

Shri Akshay Kaushik
Scientist 'B', BIS

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